

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, NEGATIVE GRID (MICROWAVE)
TYPE 8906 *

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the electron tube described herein shall consist of this document and the latest issue of MIL-PRF-1.

DESCRIPTION: Triode, planar, ceramic, and metal.

See figure 1.

Mounting position: Any.

Weight: 1.8 ounces (48 grams) nominal.

ABSOLUTE RATINGS:

Parameter:	F	E _f	E _b	ep _y	E _c	i _b	I _b	i _c	t _p	D _u	P _p
Unit:	GHz	V <u>1/</u>	V dc	kv	V dc	a <u>2/</u>	mA dc	a	μs	---	W
Maximum:											
Anode pulsed osc or amp:	3.0	6.0 ±5%	---	4.5	-150	5.0	---	2.5	6.0	0.0033	10
Grid pulsed osc or amp:	3.0	6.0 ±5%	3,500	---	-150	5.0	---	2.5	6.0	0.0033	10
Test conditions:	---	6.0	600	---	Adj	---	25	---	---	---	---

ABSOLUTE RATINGS:

Parameter:	P _g	t _k	TE	T(anode shank)	Barometric pressure reduced	Cooling
Unit:	W <u>3/</u>	sec (min)	°C <u>4/</u>	°C <u>4/</u>	mmHg <u>6/</u>	--- <u>5/</u>
Maximum:						
Anode pulsed osc or amp:	2.0	60	250	250	---	Conduction and convection
Grid pulsed osc or amp:	2.0	60	250	250	35	Conduction and convection
Test conditions:	---	300	---	---	---	<u>7/</u>

GENERAL:

Qualification: Required. 18/

* Replaces EIMAC Y-572.

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TABLE I. Testing and inspection.

Inspection	Method	Notes	Conditions	Acceptance level <u>19/</u>	Symbol	Limits		Unit
						Min	Max	
<u>Conformance inspection, part 1</u>		<u>17/</u>						
Insulation of electrodes	1211	---	Eb = Ek = 0; Ec = -500 V dc	0.65	R	50	---	Meg
Electrode voltage (1) (grid)	1261	---		0.65	Ec	-4.5	-9.5	V dc
Total grid current	1266	---		0.65	Ic	---	-2.0	μA dc
Pulsing emission	1231	---	eb = ec = etd/is = 10.0 a; tp = 3 μs (max); prr = 600 (max)	0.65	etd	---	200	v
Heater current	1301	---		0.65	If	0.90	1.05	A
<u>Conformance inspection, part 2</u>								
Resonance test	---	<u>9/ 10/</u>	No voltages applied	---	---	---	---	---
Electrode voltage (2) (grid)	1261	---	Eb = 1,000 V dc; Ec/lb = 1.0 mA dc	---	Ec	---	-30	V dc
Direct-interelectrode capacitance	1331	<u>9/</u>	No voltages applied; fixture in accordance with Drawing 158-JAN	---	{ Cin Cgp Cout	7.0 1.85 ---	9.0 2.10 0.06	pF pF pF
Power oscillation (pulse)	1236	<u>9/ 12/</u>	F = 3.0 GHz (min); epy = 3.5 kv; Ec = -1.5 V dc (min); Rg/lb = 12.0 mA dc (max); Ic = 7.0 mA dc (max); Ef = 5.8 V	---	Po	6.0	---	W (useful)
Power gain	---	<u>13/</u>	F = 1,100 ± 100 MHz; Ebb = 2,200 V dc; Ecc = -50 V dc; tp = 3 μs (min); Du = 0.002 (min); pd = 400 w	---	po	1.8	---	kw

See footnotes at end of table.

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TABLE I. Testing and inspection - Continued.

Inspection	Method	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
<u>Conformance inspection, part 3</u>							
Life test	---	16/	Group C; Ef = 6.0 V; filament standby; t = 500 hours	---	---	---	---
Life-test end point	---	16/		Δi_b ΔC_{gp}	---	25 0.15	% pF
Variable-frequency vibration	---	9/ 11/ 14/	F = 55 to 500 to 55 Hz; Accel = 10 G peak (min); Ebb = 300 V dc; Rp = 10,000 ohms; Ec/lb = 10 mA dc	Ep	---	250	mV ac
Torque	---	9/ 11/ 15/	No voltages applied	---	---	---	---
Shock, specified pulse	1042	11/	Condition A; no voltage applied; fixture in accordance with Drawing 280-JAN	---	---	---	---
Torque and shock-test end point:	---						
Total grid current	1266	---		Ic	---	-10	μ A dc
Barometric pressure, reduced	1002	8/ 11/	Pressure = 35 mmHg (max); voltage = 2,000 V ac; TA = 30°C \pm 10°C	---	---	---	---

- 1/ The transmit-time heating effect of the cathode shall be compensated for by a reduction in heater voltage after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of ± 5 percent from optimum is permitted. No reduction in heater voltage is required up to and including 500 MHz.
- 2/ The regulation, or series anode supply impedance, or both, shall limit the instantaneous peak current, with the tube considered as a short circuit, to a maximum of 10 times the specified maximum current rating.
- 3/ The maximum instantaneous peak grid voltage for grid-pulse conditions shall be within the range of +250 to -750 volts.
- 4/ Sufficient conduction and convection cooling shall be provided to limit the envelope and anode shank temperatures to the specified maximum value under all operating conditions. Reliability will be seriously impaired if this maximum is exceeded. Where emphasis is placed on long and reliable life, lower temperatures should be maintained.
- 5/ Sufficient cooling shall be provided for all seals to limit temperature in accordance with 4/. In cases where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

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TABLE I. Testing and inspection - Continued.

- 6/ Operation at this altitude is possible in a suitably designed circuit.
- 7/ In all electrical tests involving applications of heater voltage, sufficient conduction, convection, or forced-air cooling may be provided for all seals to limit temperatures.
- 8/ Voltage shall be 60 Hz ac applied between anode and grid. No other voltages shall be applied. There shall be no evidence of failure as indicated by arc-over. This is not a destructive test.
- 9/ Other tube contact configurations may be used provided the tube contact area remains unchanged and the socket, jig, or cavity gives equal performance. Mounting of the socket, jig, or cavity may be at the option of the manufacturer.
- 10/ Grid-anode resonance. Test in cavity in accordance with Drawing 278-JAN. Cavity shall resonate at $1,354 \pm 2$ MHz with tuning slug in accordance with Drawing 277-JAN at $TA = 25^{\circ}C \pm 5^{\circ}C$.

Grid-cathode resonance. Test in cavity in accordance with Drawing 283-JAN. Cavity shall resonate at $1,719 \pm 2$ MHz with tuning slug in accordance with Drawing 277-JAN at $TA = 25^{\circ}C \pm 5^{\circ}C$.

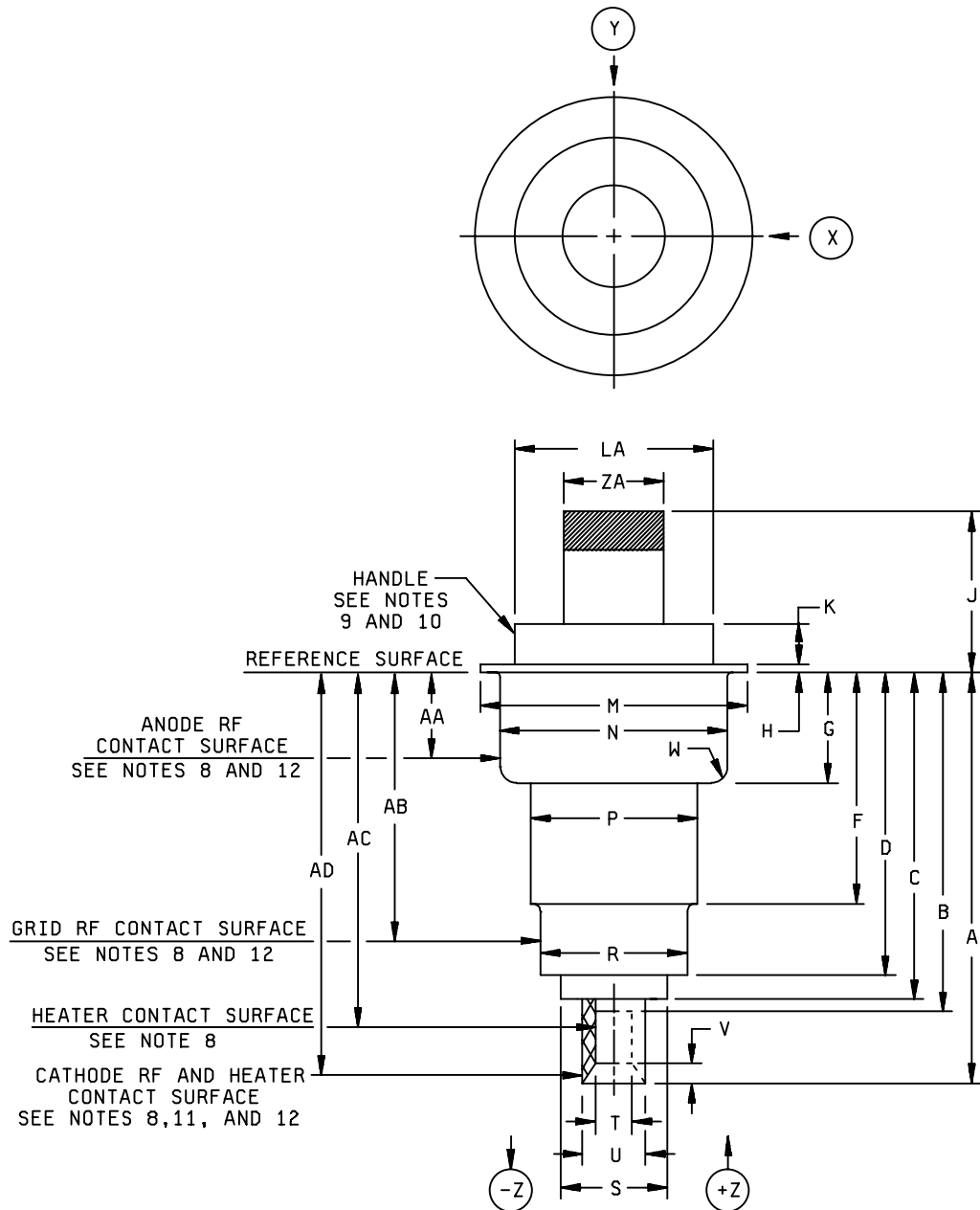
When plotted on graphs of resonant frequency versus grid-anode capacitance and resonant frequency versus grid-cathode (input) capacitance, the tube under test shall be represented by a point within a parallelogram whose four corners are located by the following points:

Points	Capacitance (pF)		Frequency (MHz)	
	Cgp	Cgk	Fgp	Fgk
1	1.85	7.0	2010	1760
2	1.85	7.0	2040	1800
3	2.10	9.0	1940	1720
4	2.10	9.0	1970	1760

- 11/ This test shall be performed during the initial production and once each succeeding 12-calendar months in which there is production. An accept on zero defect sampling plan shall be used, with the sample of three tubes with an acceptance number of zero failures. In the event of failure, the test will be made as a part of conformance inspection, part 2, with an acceptance level of 6.5 (see 19/). The regular "12-calendar month" sampling plan shall be reinstated after three consecutive samples have been accepted. None of the testing shall be considered as destructive except in case of failure.
- 12/ The applied voltage pulse shape shall be measured with a noninductive resistor of $1,150 \text{ ohms} \pm 2$ percent inserted in place of the tube. The pulse shape shall be: $t_p = 3.0 \mu s \pm 10$ percent, $t_r = 0.4 \mu s$ maximum, and $t_f = 0.7 \mu s$ maximum. The pulse repetition rate (prf) shall be adjusted so that $D_u = 0.0025 \pm 5$ percent with the above measured pulse length. Test in cavity in accordance with Drawing 279-JAN. The cavity shall be connected to a load with a VSWR less than 1.5/1. The oscillator output coupling and the grid or cathode resistor may be adjusted for maximum power output.
- 13/ Test shall be conducted in power amplifier cavity as shown on figure 2, or equivalent. Driving power is defined as the net power delivered to the amplifier cavity input terminals and the reflected power shall be subtracted from the incident power to obtain the net driving power. The output tuning shall be adjusted for maximum power output.

TABLE I. Testing and inspection - Continued.

- 14/ The tube shall be mounted in the socket in accordance with Drawing 276-JAN and vibrated with simple harmonic motion. The peak acceleration over the frequency range shall be within ± 20 percent of the reference acceleration at 100 Hz. The frequency shall vary from 55 to 500 Hz and return to 55 Hz with approximate logarithmic progression and shall require 4 minutes minimum, 6 minutes maximum, to traverse the range. Each tube shall be vibrated for 30 minutes in each axis X and Z except that if the cumulative result of test on 50 or more tubes of a construction show that more than 75 percent of the tubes have a higher output voltage in one position, subsequent measurements need to be taken only in the axis giving the higher readings. The voltages specified herein shall be applied to the tube during vibration. The value of the alternating voltage, E_p , produced across the resistor, R_p , as a result of vibration, shall be measured with a suitable device. The device shall have an appropriate voltage range, and shall have the ability to measure, with an error less than 10 percent, the rms value of a sine wave of voltage at all frequencies from 20 to 20,000 Hz. The value of the vibrational output, E_p , shall not exceed the limit specified herein at any point in the sweep frequency range during the last complete cycle of cycling vibration.
- 15/ The torque test shall be performed as follows:
- a. The tube shall be held securely at the cathode connection. A force of 5 pounds shall be applied to the heater cup without perceptible shock. This test may be made by applying the force at right angles to the inside of the cup at a point $7/64$ -inch (2.77 mm) \pm $1/64$ -inch (0.41 mm) from the cathode end of the tube. An approved equivalent method may be used. The heater cup shall not loosen or short circuit to the cathode connection.
 - b. A rotational torque of 15 inch-pounds shall be applied between anode and cathode without shock.
 - c. A rotational torque of 40 inch-pounds shall be applied between anode and grid without shock.
 - d. A rotational torque of 30 inch-pounds shall be applied, both clockwise and counter-clockwise, between the anode cooler and the anode contact surface, with no resulting loosening of the anode cooler or damage to the tube.
- 16/ At zero hours, measure the grid-anode capacitance (C_{gp}), and establish the drive conditions necessary to obtain 3.0 amperes peak anode current with an anode voltage of 1,000 V dc and a bias voltage of -40 V dc. The pulse width of the modulator shall be 2 μ s minimum and the duty cycle shall be 0.025 maximum.
- At the completion of life test, C_{gp} is measured and the change from the original value (ΔC_{gp}) may not exceed the specified limit; under the same operating conditions and with the drive level determined at zero hours, check the anode current at the end of life, and the change from the original value (Δi_b) may not exceed the specified limit.
- 17/ All tests listed under conformance inspection, part 1, shall be performed at the conclusion of the holding period.
- 18/ In addition to the requirements specified herein, compatibility testing shall be required in the AN/ARN-52(V) Tacan Set. A sample of 20 tubes shall be supplied to NAD Crane, Code QEEL on a noninterference basis. Of the 20 tubes to be supplied, a sample of 4 tubes shall be selected for life tests. Each tube shall achieve a minimum of 500 hours operation. In the event of no failures, the sample shall be considered as acceptable when a total of 1,600 hours have been accumulated.
- 19/ This specification sheet uses accept on zero defect sampling plan, in accordance with MIL-PRF-1, table III.



NOTE: When type 8906 tubes being tested in this document have been made in the same production run as the JAN-7815 tubes and the listed dimensions are identical, then the one sample may represent both types.

FIGURE 1. Outline drawing of electron tube type 8906.

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Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
Conformance inspection, part 2					
A	1.815	1.875	46.10	47.62	
B	---	1.534	---	38.96	
C	---	1.475	---	37.46	
D	1.289	1.329	32.74	33.76	
F	.970	1.010	24.64	25.65	
G	.462	.477	11.73	12.12	
J	.766	.826	19.46	20.98	
N	1.025	1.035	26.04	26.29	5, 13
R	.655	.665	16.64	16.89	5, 13
T	.213	.223	5.41	5.66	6, 13
U	.315	.325	8.00	8.26	5, 6, 13
Conformance inspection, part 3					7
H	---	.040	---	1.02	
K	---	.185	---	4.79	
M	1.180	1.195	29.97	30.35	
P	.752	.792	19.10	20.12	
S	---	.545	---	13.84	
V	---	.086	---	2.18	
W	---	.100	---	2.54	
LA	.840	.860	21.34	21.84	
ZA	.427	.447	10.85	11.35	
Electrode contact areas					14
AA	.035	.361	0.89	9.17	1, 5
AB	1.185	1.265	30.10	32.13	2, 5
AC	1.534	1.728	38.96	43.89	3, 6
AD	1.475	1.815	37.46	46.10	4, 5, 6

FIGURE 1. Outline drawing of electron tube type 8906 - Continued.

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NOTES:

1. Anode rf contact surface and reference dimension for eccentricity measurements.
2. Grid rf contact surface and reference dimension for eccentricity measurements.
3. Heater contact surface and reference dimensions for eccentricity measurements.
4. Heater and cathode rf contact surface and reference dimensions for eccentricity measurements.
5. The total indicated runout of the anode and grid contact surface with respect to the cathode contact surface shall not exceed .020 inch (0.51 mm.)
6. The total indicated runout of the cathode contact surface with respect to the heater contact surface shall not exceed .012 inch (0.30 mm).
7. These dimensions shall be tested monthly when in continuous production, with zero failures allowable during double sampling, with a minimum of four samples each.

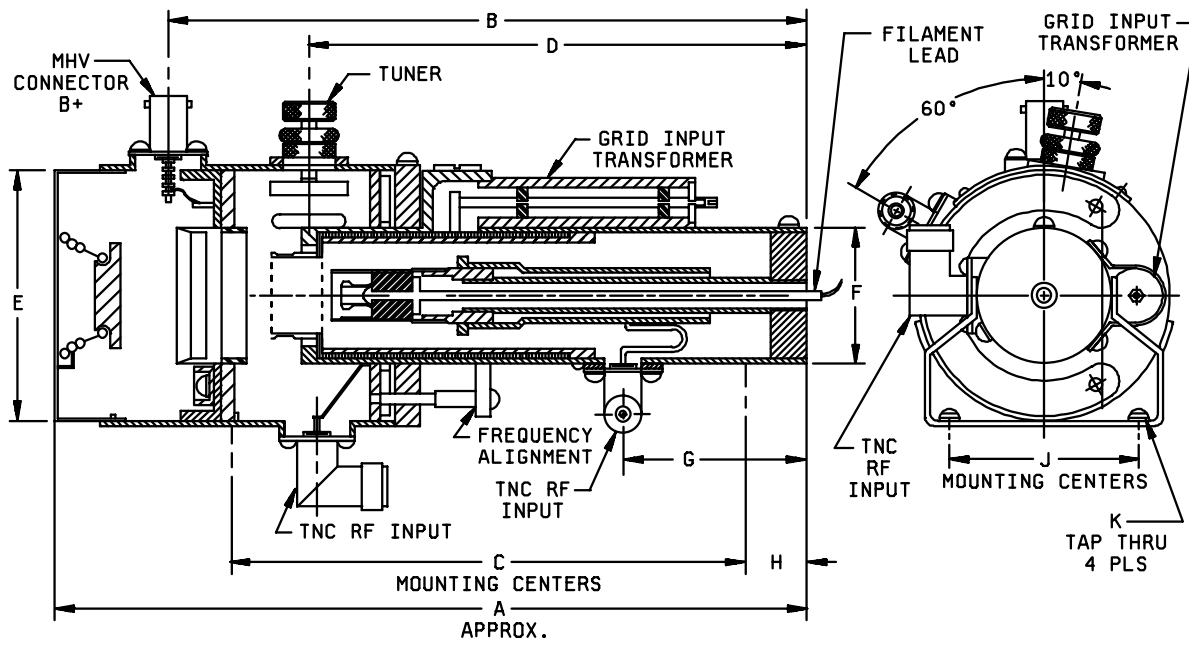
In case of failure after double sampling, the failing dimension(s) shall become conformance inspection, part 2, acceptance level 6.5, inspection level S3. After three consecutive successful submissions, the sampling may revert to the double sampling plan.

8. Silver plated 30 MSI minimum.
9. Plating not required over radiator or handle support of copper, aluminum, or approved equivalent.
10. This surface shall be used for measurement of anode shank temperature.
11. Inner edge of heater and outer edge of cathode rf connection shall be free from burrs and sharp edges. Insulated material between heater and heater-cathode shall be securely affixed.
12. Total indicated runout (T.I.R.) of contact surfaces shall be gauged from center line of reference and shall be as follows. Note 7 shall apply.

<u>Contact surface</u>	<u>TIR maximum</u>	<u>Reference</u>
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

13. Diameters N, R, T, and U shall apply throughout entire contact areas as defined by dimensions AA, AB, AC, and AD, respectively.
14. Dimensions in electrode contact areas table are for socket design purposes and are not intended for Inspection purposes.

FIGURE 1. Outline drawing of electron tube type 8906 - Continued.



Ltr	Dimensions	
	Inches	Millimeters
	Nominal	Nominal
A	6.97	177.04
B	5.72	145.29
C	4.72	119.89
D	4.56	115.82
E	2.50 O.D.	63.50 O.D.
F	1.25 O.D.	31.75 O.D.
G	1.56	39.62
H	.62	15.75
J	1.88	47.75
K	4-40 NC-28	4-40 NC-28

NOTE: All dimensions are for reference only.

FIGURE 2. Pulse amplifier cavity.

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Custodian:

Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5960-3693)

Review activities:

Navy - AS, CG, MC, OS